Design Studies and Intelligence Engineering
L.C. Jain et al. (Eds.)

doi:10.3233/FAIA220721

Customized Generation and Creative Practice of Asian Games Kinetic Sports Pictograms in Game Engine

Xuan Xuejun[a,1] and Yao Chi[b]
[a,b] *China Academy of Art*

Abstract. Kinetic pictograms are more effective in communication and easier to attract attention compared to static pictograms. The kinetic sports pictograms of the 19th Asian Games continues the visual identity of the Games, showing the beauty of the flowing lines while also enhancing the overall publicity effect of the Asian Games visual design. Starting from the technical selection, this paper explains the process of creating and practicing the Customized Generation of kinetic sports pictograms in the game engine through the difficult breakthroughs in action design, graphic personalization and spatial deformation, combining the laws of sports. Thus, it also provides some reference and thinking for the expansion and innovative practice of game engines in different creative application scenarios.

Keywords. Kinetic Pictograms, Game Engine, Customized Generation

1. Origin

With the development of information technology, the way of disseminating information has become diversified, and various media technologies provide a good environment for the development and application of kinetic pictograms. With the evolution of event communication technology, the design and application of kinetic sports pictograms, as a popular form of creation nowadays, has become the mainstream trend of visual image of large-scale events. Compared with static pictograms, kinetic pictograms are more interesting and communicative, conveying information better than static and attracting audience's attention more easily. In order to achieve better promotion of the Asian Games, show the concept of intelligent Asian Games and comply with the development trend of new media, Hangzhou Asian Games Organizing Committee decided to carry out the design of kinetic sports pictograms. As a landmark achievement of the Asian Games, the kinetic sports pictograms is one of the most important visual identity of the Hangzhou Asian Games, which is also the first set of kinetic sports pictograms in the Asian Games history.

The visual elements of the kinetic sports pictograms of the Asian Games are evolved from the static sports icons, and the fixed-frame pictograms are consistent with the original static sports pictograms. Based on following the functional principle of sports icons, motion capture and game engine are adopted as the core technology of the design, and the sports pictograms are interpreted through dynamic motion process, background brushing and fixed-frame display three steps ,to form the final smooth animation effect.

[1] Corresponding Author, School of Animation and Games, China Academy of Art, Building 4, No.352 Xiangshan Rd., Xihu District, Hangzhou, Zhejiang, P.R.China; E-mail: xuanxj@caa.edu.cn.

This Asian Games kinetic sports pictograms motion production was an innovative challenge from the initial motion design to the post-production, considering both the readability of the icon as an information carrier and consistent with the visual identity of the Asian Games.

According to the agreement, our team and Prof. Yuan Youmin's team co-led the project, conducted extensive research and started the design, under the guidance of Hangzhou Asian Games Organizing Committee and related parties, spent one and a half years repeatedly revising and optimizing the project, and created it together.

2. Pre-testing and exploration

2.1. Preliminary research and testing

In the pre-design stage, our team went through a long process of research, analysis, discussion and trial and error. First, we studied a large number of competition videos and animations, and carefully analyzed the existing information of these movements. At the same time, professional organizations and athletes were also consulted to summarize the essentials and characteristics of each sport's movements and mark out the most representative action forms. The sports icons were also categorized according to the difficulty and magnitude of the dynamic rendition, so as to facilitate the design of dynamic rendition in groups later.

Then comes the test and trial and error. According to the traditional animation production method, multiple groups of testing paths such as 2D and 3D were developed. Taking 2D animation as an example, the degree of creative freedom was high and the movement performance was flexible, so the first demo was completed in a short time. However, a harsh reality was found in the subsequent production process, which meant a huge amount of repetitive work when faced with a full set of motion creation and modification. At the same time, because the graphics is a sheet layer, turning action becomes more difficult to perform. And in the 3D direction of design attempts, difficulties were encountered at the beginning, because the design of static motion icons is not defined according to the human skeleton, the lack of joint connections between the head, body and limbs, and the proportional relationship between the limbs of the icons is not fixed, after many attempts we still failed to achieve a satisfactory results.

2.2. Toolbox selection and iterative evolution

After our previous rounds of trial and error and demo design production, the selection of the creation toolbox became very urgent and the technology selection was on the agenda. The traditional animation production method seems to be unsuitable for this particular kinetic sports pictograms design and production, at least not as the main tool anymore. Combined with our own professional accumulation and achievements, the toolbox became clear after continuous trial and error, and from the iterative results we slowly sorted out a practical and innovative path.

First, the game engine as the main development tool for the design and production of the sports pictograms; then, use the depth camera for real-time performance of motion capture to further validate and action reference, and thus improve the production efficiency and accurate expression of the action; finally, through the integration of the

common software for the details of the trimming and perfection, to complete the entire series of sports pictograms.

This is a complex iterative and experimental process, in the early creation process ,we have iteratied and verified several times, not only completed the selection of technology, but also finally formed a more mature creation method at the same time.

3. Path of creative practice

3.1. Specification development

3.1.1.Timeline specification

In terms of the timeline specification, the timeline specification of the kinetic pictograms was finally determined based on the condensed action characteristics and performance time through the analysis of sixty individual sports pictograms and time duration one by one. The duration of the entire kinetic pictograms was determined to be 2.5 seconds and consisted of two segments: the average duration of the dynamic expression of the action was 2 seconds; the average duration of the fixed-frame was 0.5 seconds, so as to facilitate the action brushing in the sectoral base map. And allow the two time segments between the lower range of reasonable floating adjustment, according to the different types of action in the case of the total duration of the same.

3.1.2. Action specification

In terms of action specification, on the one hand, the action range area is standardized to ensure that the proportional relationship and the visual center will not deviate, and at the same time to maintain coordination when multiple groups of icons appear at the same time. At the same time, all the movement types are divided into four categories according to the difficulty coefficient of movements, distinguishing from limb movements, body movements to turning and double movements, and extracting representative perspectives and movements for specification.

3.1.3. Visual specification

In terms of visual specification, it is mainly reflected in the unified specification with the static frame and the unification in color. With the Asian Games static sports pictograms as the standard set of static frame, to ensure the unified specification of the fixed-frame. In particular, the thickness and style of the double lines of the icons are standardized, and different line thicknesses and more than ten types of line endpoints are set to facilitate flexible and standardized use during production. In addition, the final color application is also very important to unify the color system of Asian Games icons in color and carry out the strict implementation of the standard.

3.2. Technology selection process

After a lot of technical research in the early stage of our project, we tested different realization paths with existing software and technology in the professional field, compared and analyzed the advantages and disadvantages.

3.2.1. Traditional 2D hand-drawn animation

The advantage of traditional hand-drawing is freedom, a good original artist can express the action in his mind as he wishes, and can draw a very artistic effect. However, as this project has extremely strict requirements for the final presentation, which requires smooth lines, uniform thickness and strict consistency with static pictograms, it is difficult to achieve uniformity in the lines in the traditional hand-drawn way. The movement requires strict realistic, there must be a lot of modification and adjustment, and the rework cost is high frame by frame.

3.2.2. 2D vector frame-by-frame animation

Using vector software such as Illustrator to outline each frame of the icon can ensure the smoothness of the lines, but the production cost is extremely high, and the modification of the action will lead to repetition over and over again, which brings great time cost and makes the project schedule extremely uncontrollable.

3.2.3. 2D computer interpolation animation

The interpolation calculation is performed with Flash's shape change animation, thus requiring only keyframes to be drawn, which can greatly save modification time. Theoretically, this is a more suitable path, but in practice, we encountered the following difficulties.

a. Flash's vector interpolation algorithm is very imperfect, when the action is a little large, the deformation animation becomes distorted and uncontrollable, resulting in a lot of manual modification.

b. Although the double line animation can be used as single line Offset, the joint part still needs a lot of manual drawing.

c. Switching to single line animation and then automatically hooking the edge can solve part of the problem, but the Flash plug-in needs to be developed to solve the problem of smooth interpolation of bezier curves.

Figure 1. 2D computer interpolation animation Practice.

3.2.4. 3D Animation

We tested the model with polygon, Curve, pipe, etc., tested the animation with bone binding, deformer control, and finally gave up considering the following problems.

a. The motion of the bilinear system needs to be strictly aligned, and the corners cannot be extruded and deformed.

b. The middle of the two-line model cannot be empty, but needs to be masked to each other.

c. The model cannot have polygon jaggedness after zooming in.

d. When the model is turned to face, it is not a 3D pipeline, but needs to be an artistic 2D icon effect.

e. A lot of rendering time is needed from each animation adjustment to the finished effect.

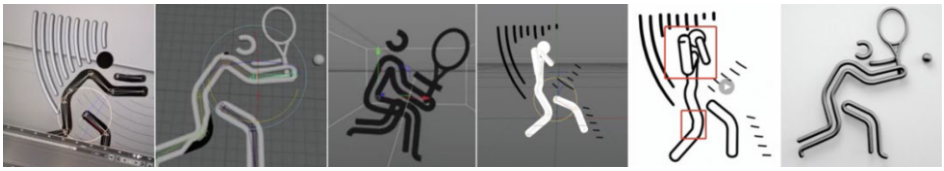

Figure 2. 3D Animation Practice.

3.2.5. 3D Mixamo Animation

Due to the large number of sports actions involved, we also considered using Mixamo to speed up the animation, but Mixamo has strict requirements for the model, which requires an integrated crack-free model, and our two-line model cannot be bound properly.

Figure 3. 3D Mixamo Animation Practice.

3.2.6. Game engine development

After detailed research and trial and error, we found that because of the specificity of this project, there are no suitable tools readily available, so we had to develop our own dedicated tools to face these challenges, to procedurally generate Mesh animations, and to be assisted by motion capture for motion design.

3.2.6.1. Tool development for game engine (real-time rendering)

a. Procedural generation of individual Mesh
b. Generate nodes
c. Procedural generation of Mesh based on node distances
d. Procedurally generate Mesh based on radians
e. Generate Mesh based on endpoints
f. Make double pass, three pass, four pass nodes
g. Create Shader and Material
h. Write editor tools
i. Combine with the animation function of the engine, use the editor tool to adjust the animation
j. Use export program to export the animation to the specified format

3.2.6.2. Calibration and reference of motion capture

We use motion capture for auxiliary reference in practice, so that the motion of some joints becomes clearly visible, and it is convenient to unify the standard when different animations are made.

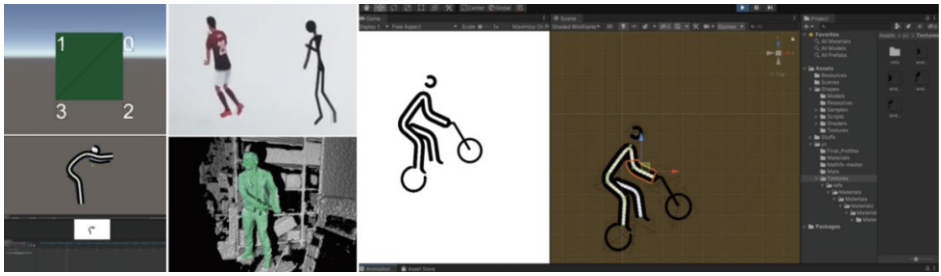

Figure 4. Motion capture and game engine development process.

3.3. Difficulties and breakthroughs

3.3.1. Bone binding issues

If we carefully analyze the double-line style kinetic sports pictograms released this time, we will find that the graphic structure has many individual settings, which cannot be bound by the skeleton system in the traditional animation design, and the double-line shape will also encounter very many problems when turning the surface. So we finally did not use the traditional animation production software and methods, but solved this problem through the game engine.

3.3.2. Motion design issues

In the design process of kinetic pictograms, the performance of movement is the key to show the characteristics of sports. In order to make the character movement natural and smooth, while conforming to the action specifications and animation rules, appropriate artistic expression must be exaggerated to enhance the expressive power of movement. At the same time, since the overall motion of the kinetic pictograms is controlled in about two seconds, nearly half of the time in the two seconds needs to be used to meet the "bullet time" required to take over the static pictograms, so in the selection of the motion especially need to select a representative and in line with the length of the action, and

completed within a limited time. In addition, considering the linearity limitation of the Asian Games kinetic sports pictograms, when both arms go up at the same time, the movement of the upper body will show a more abrupt "凵" shape, so the action design needs to appropriately modify half of the arm movements to "√" form to achieve the coordination and beauty of the movement.

3.3.3. Graphic personalization issues

The design of the static sports pictograms of this Asian Games is from the perspective of aesthetics and visual balance. While unifying the style, each icon actually has personalized adjustments, with different line thickness and endpoint processing. This means that when doing kinetic pictograms also have to pay attention to these details, and after the movement many details will exist more complex changes, such as the front and back of the line overlap, bending nodes, line endpoints and so on. Due to different sports postures, the overall sense of different static pictograms varies. In order to achieve overall visual harmony, the icons are fine-tuned in details, such as the thickness of the lines and the distinction of gestures, which also means that each kinetic pictograms to the static articulation needs to be refined to fit the process. In order to make the initial action perfectly connected with the static action at the end, it is necessary to make a set of exclusive hand and foot parts for each sports icon.

3.3.4. Spatial deformation problem

Compared with two-dimensional plane action, three-dimensional space action can obviously make the dynamic more tension and vivid, and many sports in the turning action is also a key feature point. For example, in artistic gymnastics, in order to show the characteristics of the sport as well as to consider the freeze frame action at the end of the frame, the design of turning action was finally determined. The only distinction that can be made is the difference between the front and back of the gestures, which indirectly reflects the turning motion of the linear figure. In order to reflect some flexible characteristics of the linear character, the whole body is not bound to the skeleton in the unity animation, but the human body is divided into several pieces of line segments, and the overall character movement is changed by adjusting the position of each piece of line segment. This is conducive to the shaping of human movement, but also easy to lead to the phenomenon that distortion the shape in large movements. In the production process of turning movement, the problem of distortion and shape change is finally solved through the adjustment of the screen perspective and the frame-by-frame debugging of some movements.

4. Technology Empowerment Thinking

With the rapid development of times and technology, design is also changing unconsciously. Compared with static icons, dynamic icons are more and more widely used because of their flexibility and rich effects. As the first kinetic sports pictograms in the history of the Asian Games, it not only reflects the spirit and characteristics of the sports, but also discovers a set of practical means of creation in the process of design

practice. By overcoming many difficulties, it finally tried the practical path of dynamic linear icons with comprehensive and innovative design language, which is a vivid case of digital empowerment design.

The application of game engine from design to production in this project is an important breakthrough, and I believe it will give many visual designers and animation designers a fresh reminder to expand their respective design toolbox. It is foreseeable that the application of game engine will be more widely used besides the game field. It provides very rich rendering, animation and special effects modules, while its powerful programming development capability can greatly expand the expressive power of design and derive more design tools and innovative visuals. At the same time, with the continuous introduction of artificial intelligence in game engines, the combination with design will become more and more intelligent, and more fresh visual elements and innovative paths will be born as a result, stimulating the imagination of creators.

The design toolbox will be increasingly rich in the future, and we are looking forward to continue opening it.

(Results of Design-AI Lab, China Academy of Art)

References

[1] Jared Halpern, *Unity 2D Game Developer*, Tsinghua University Press, 2020-06-01.
[2] Donald H. House, John C. Keyser, *Foundations of Physically Based Modeling and Animation*, Publishing House of Electronics Industry, 2019- 10-01.
[3] Xuan Yusong, *Unity 3D Game Development (2nd Edition)*, Posts & Telecom Press, 2018-09-01.
[4] Patrick Felicia, *Getting Started with 3D Animation in Unity*, Independently Published, 2018- 12-03.
[5] Alan Thorn, *Unity Games Animation Design*, Tsinghua University Press, 2016- 10-01.
[6] Yao Liang, *Unreal Engine UE4 Technical Basics*, Posts & Telecom Press, 2020-02-01.
[7] Mao Judong, *Cocos Creator 2.x: Getting Started with Games*, Tsinghua University Press, 2020- 12-01.
[8] Nancy Beiman, *Animated Performance: Bringing imaginary animal, human and fantasy characters to life*, China Youth Publishing Group, 2020-07-01.
[9] Wu Tao, Wu Fukui, *Motion Capture Technology and Virtual Modeling Fundamentals Tutorial*, Huazhong University of Technology Press, 2022-02-01.
[10] SendPoints, *Chinese Pictograms: The Pictographic Evolution & Graphic Creation of Hanzi*, SendPoints, 2019-04-23.